
HVAC: Installed Air Conditioner System Efficiency

Description

The proposed changes for residential buildings are:

1. **Refrigerant and Evaporator Airflow.** AB 970 changes implemented a prescriptive requirement for verified refrigerant charge and airflow. Due to this new option, a review of, and possibly change to, the calculations, methods of test, or methods of verification based on recent studies will occur. In addition, the refrigerant charge and airflow could be extended to apply to TXV systems, an option which is currently not allowed. The AB 970 changes also extended the refrigerant charge and airflow measure to replacement air conditioners. This area will be reviewed.
2. **Fan Power.** In the calculation for the seasonal energy efficiency ratio (SEER), the assumption is that air handlers consume 365 W/1000 cfm, but there is no test or standard for the power of air handler fan/motor assemblies. The result is that fan power generally exceeds 500 Watts and often approaches 1000 Watts. Under the proposed change, a method would be developed to account for fan watt draw and an option provided for a credit for reducing fan power. This specification could include verification of fan power or other significant variables at the installation. It could also include specifications of particular fan/motor assemblies that have a certified level of efficiency. This change would revisit the calculations associated with the installed air conditioner efficiency.

Benefits

Residential air conditioning systems waste energy because they operate at efficiencies below their laboratory efficiencies. This factor is due to a number of widespread installation issues, including incorrect refrigerant charge, improper evacuation, low evaporator airflow, and high static pressures. Obtaining an installation that has proper refrigerant charge, proper evaporator airflow, reasonable static pressures, and lower fan watt draw reduces energy consumption, and is particularly effective at reducing peak electrical consumption.

Correct refrigerant charge and airflow produce more even-delivery temperatures and higher comfort, while reducing fossil fuel emissions. Units with proper airflow produce more sensible capacity, which is needed in California's hot dry climates. Units with too much or too little charge are more prone to compressor failure and higher repair costs.

Changes or alternatives to the airflow test methods could increase the number of units with correct airflow. Changes in verification techniques could lower the cost, and increase the percentage, of units implementing these measures.

Improved installation practices promoted through these changes are likely to raise the level of these practices; thus reducing the amount of ozone-depleting R-22 released into the atmosphere.

Time Dependent Valuation would point out the outstanding peak reduction benefits of these measures.

Environmental Impact

These changes produce only positive environmental impacts. Environmental emissions are lowered because of the reduced annual energy consumption and, more importantly, because of the reduced consumption on peak, when the more polluting power plants are on line.

Type of Change

The refrigerant and evaporator airflow changes would modify the requirements in the TXV/Airflow-Charge portion of Prescriptive Package D.

The fan watt draw changes would also be implemented as revisions to the TXV/Airflow-Charge portion of Prescriptive Package D. A new requirement related to reducing actual fan power would be added. An investigation will determine whether this limit should be stated in terms of floor area, air flow, or compressor capacity. All the Standards documents would have to be revised.

Measure Availability and Cost

Testing and obtaining proper refrigerant charge and evaporator airflow has been taught and practiced in California in the recent past. Utility and CEC programs have trained technicians in the proper application of the Title 24 specifications, and compliance is within the grasp of any competent installer. There is no additional labor cost associated with meeting the standard for a contractor who is currently checking charge and airflow as specified by the manufacturer. The cost of verification varies with the package of measures, and whether this is a single installation or part of a development.

For fan watt draw, air-handler fan/motor assemblies come in a variety of efficiencies. The installed efficiency is largely dependent on the quality of the duct system design and installation. Various manufacturers offer higher efficiency fan motors in a number of air handlers. These high efficiency fan motors are substantially more expensive than standard fan motors. Properly designed duct systems, with lower static pressure and attention to the inlets to the fan box, may be more cost effective than the high efficiency fan motors in achieving adequate airflow with lower watt draw than currently seen in the field.

Useful Life, Persistence and Maintenance

Over the life of the system, adequate airflow provides improved efficiency compared to systems that have inadequate airflow. Subsequent events may reduce the airflow of either system, but the system that started with better airflow and efficiency will remain better.

Performance Verification

The current *Standard* requires verification for TXVs, as well as charge and airflow. The changes proposed should have verification requirements sufficient to ensure high performance for the substantial majority of the time, without causing undue economic burden or time delays to building completion. Installation of an air-handler with a high efficiency fan/motor assembly could be verified by checking the model number of the fan motor. Adequate airflow verification could require measurement of total airflow. Fan watt draw could be verified using the utility electric meter.

Cost Effectiveness

The cost and estimated savings will be analyzed to determine cost effectiveness for each proposal. Charge and airflow verification for TXV systems will cost the same as it does for systems without TXVs. Because of the effect of the TXV, there will be less energy and demand savings than on a system that does not have a TXV, however this verification is still expected to be cost effective.

Analysis Tools

The primary analysis tools for these changes will be the energy and peak consumption simulation models developed by Proctor Engineering Group.

Relationship to Other Measures

The efficiency of the duct system is quite dependent on cooling equipment airflow and performance. When third-party verification is required, the cost per measure is reduced when multiple tests can be completed at the same time.

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